

## The Stolt Report:

An investigation into the escape of  
Atlantic salmon from the Eden Island site.



BC Fisheries



## PURPOSE OF THE INVESTIGATION

In response to a report received on September 15, 1999, from Stolt Seafarm Inc. (the "operator" or "company") that there had been an escape of Atlantic salmon from its Eden Island site, staff commenced an investigation under the authority of the **Fisheries Act, R.S.B.C. Chapter 149** and **Aquaculture Regulation** to:

1. Identify the circumstances, nature and cause of the escape.
2. Identify and review the operator's escape prevention, detection and response practices.
3. Make findings and recommendations for the operator.
4. Make any other findings and recommendations.

## THE BRITISH COLUMBIA FISHERIES ACT REGULATORY REGIME

In accordance with the **Fisheries Act**, every salmon farm requires an aquaculture license. The aquaculture license contains general operating terms and conditions, including requirements that an operation comply with standards established by the Branch (i.e. BCF) in consultation with the industry. A Development Plan that outlines site-specific requirements for an operation, including fish pen dimensions, is required to be developed by a prospective operator. This plan is usually developed through the aid of various professionals, including biologists and engineers. The plan is reviewed and approved by the provincial government before an operation can commence. Once approved by the provincial government, the plan becomes a legally enforceable term and condition of the aquaculture license.

The **Aquaculture Regulation** sets out key standards of operation for salmon aquaculture facilities, including requirements for the reporting of escapes and recapture initiatives.

Section 7 of the **Aquaculture Regulation** provides a key escape prevention regulatory standard of operation for the salmon aquaculture industry:

- 7(2) A holder shall take reasonable precautions to prevent the escape of aquatic plants or fish from the holder's aquaculture facility and from containment and attachment structures in the facility.

British Columbia Ministry of Fisheries' inspectors are responsible for **Fisheries Act**, **Aquaculture Regulation** and aquaculture license compliance and enforcement activities.

## NATURE OF THE INVESTIGATION AND AERIAL SURVEY

On September 18, 1999, the BCF investigation team was instructed to commence an investigation into an escape of Atlantic salmon from Stolt Seafarm Inc.'s Eden Island site.

On September 19, 1999, BCF staff members Bob Friesen, Manager, Licensing, Inspection and Enforcement; Charlie Twaddle, Chief Inspector, Inspection and Enforcement; and Gary Caine, Senior Biologist, Sustainable Economic Development Branch, attended at the Eden Island site and met with the following company officials: Dale Blackburn, Vice President, West Coast Operations; Hank Mitchell, Site Manager; Terry Smith, Manager of Operations; and Gary Robinson, Technical Manager.

On September 19, and 20, 1999, BCF interviewed key company officials. Subsequent interviews were conducted during the course of the investigation.

On September 19, 1999, BCF conducted a visual inspection of the site and observed a live-haul harvest operation similar to the one that took place when the company detected the escape.

On September 19, 1999, in an effort to locate the escaped fish and on direction from the Assistant Deputy Minister, BCF conducted an aerial survey covering over 200 square nautical miles involving approximately 1.5 hours of flying time. A company official was present when the aerial survey was conducted.

At the request of company officials, on September 20, 1999, BCF staff attended at the Englewood processing plant to view a sample of fish that had been harvested from Pen 12, (where the escape occurred) prior to detection of the escape.

During the course of the investigation, the investigation team (BCF staff members Bob Friesen and Charlie Twaddle) was informed that the Ministry of Environment, Lands and Parks had also commenced an investigation of the escape. Acting on direction from the Assistant Deputy Minister, BCF, to coordinate the investigation into the matter with the Ministry of Environment, Lands and Parks Conservation Service, on October 12, 1999, the team met with representatives from the Ministry of Environment, Lands and Parks. (Lance Sundquist, Regional Enforcement Manager; Dan Dwyer, Senior Conservation Officer; Larry Johnston, Conservation Officer). During the meeting, the investigation team was informed by the Ministry of Environment, Lands and Parks representatives that the Conservation Service was investigating this escape under the authority of the **Waste Management Act**. The purpose of the meeting was to develop a joint investigative approach that would capitalize on the strengths of each investigative body and reduce duplication and overlap. To the best of the investigation team's knowledge, this is the first joint Ministry of Fisheries – Ministry of Environment, Lands and Parks investigation into an escape from a salmon aquaculture operation. On December 17, 1999, the team was informed that the Ministry of Environment, Lands and Parks had concluded its investigation and involvement in this matter.

On October 1 and 18, 1999, BCF and Stolt Inc. officials attended at a net manufacturing, repair and testing facility for an examination of the net from which the fish escaped. A Ministry of Environment, Lands and Parks' Conservation Officer attended at the facility on October 18, 1999. In addition to an examination of the net by BCF, the net manufacturing, repair and testing facility assessed the condition of the net and provided an opinion on the likely cause of damage. During the October 18, 1999 visit, a demonstration was provided by the net manufacturing, repair and testing facility on the nature of the strength-test that had been conducted on the net from pen 12. During the October 18, 1999 visit, a BCF official examined a miniature model netpen. Although it was not exactly to scale, it was useful in assessing the company's explanation of events.

Records, documents and reports were obtained and examined by the team in the course of the investigation.

Photographic evidence was obtained by the investigation team and by the Conservation Officer from the Ministry of Environment, Lands and Parks.

During the course of the investigation, the current **Fisheries Act** regulatory regime was reviewed.

The investigation included a preliminary review of other jurisdictions.

Throughout the investigation, the Ministry of Fisheries' Finfish Aquaculture Specialist provided technical advice to the investigation team on various matters, including providing opinions on whether key company practices were consistent with current industry practice.

A draft report was given to the operator in order that there be a fair opportunity to comment on the report's accuracy, findings and recommendations.

A draft report was given to the Conservation Officer who was involved in this matter and to the Regional Enforcement Manager to comment on the report's accuracy, findings and recommendations.

## THE EDEN ISLAND SITE

The Eden Island site is located on the north-east shore of Eden Island bordering on the south side of Fife Sound, and five miles east of Queen Charlotte Strait (Lat. 050 45' 59" North; Long 126 39' 21" West).

The Eden Island site consists of eight "30 by 30 meter" netpens, four "15 by 15 meter" netpens, one "10 by 20" meter feedshed, one "12 by 24" meter floathouse and two "4 by 10 meter" utility floats. This was consistent with the specific requirements of the aquaculture license.

The operator reported that the escape was from pen 12. Pen 12 is one of the "30 by 30 meter" netpens. When stretched, the mesh size of the pen 12 net was measured by the BCF team to be 1.5 inches. The operator indicated that the pen 12 net was stabilized by a series of 450 pound concrete weights hanging from the net at regular intervals around the subsurface net perimeter. Evidence suggests that the distance between the point where the concrete weight was connected to the net to the actual weight itself was between 7 to 15 feet.

As required by the **Fisheries Act**, the company was operating at the Eden Island site under the authority of an aquaculture license issued by BCF.

## THE SEQUENCE OF EVENTS

Interviews with company officials and documents obtained during the course of the investigation indicate the following chronological sequence of events:

- |                        |  |
|------------------------|--|
| Pre-September 7, 1999: | Fish in pen 12 were fed twice per day with normal feeding quantities observed.   |
| September 7, 1999:     | Fish in pen 12 were last fed on this day with a normal feed response. The fish were taken off feed in anticipation of harvest the following week.  |
| September 10, 1999:    | At 3:15 p.m., a contract diver arrived at the site and dove pens 6, 8, 10 and 12 to retrieve any mortalities. As part of his duties, the diver conducted a visual inspection of the bottom of each pen's net. The diver did not report observing any abnormalities, including holes, at the bottom of the pen 12 net. Initial dive time was postponed to later in the day due to tidal currents. The diver's total time on site was reported to be one and one-half hours. |



September 14, 1999:

A livehaul boat, the Orca Chief, arrived to pick up a load of fish from pen 12. A net was put down into pen 12 to seine the fish together and to prepare for brailing. The crew experienced problems seining the required amount of fish and concluded that it was caused from strong tidal and current flows. With some extra effort the boat departed for the Englewood processing plant with a full load of fish.

September 15, 1999:

The boat returned and harvesting commenced at approximately 8:00 a.m. Six seines were attempted; with the largest being about 4,000 pieces. During these seines, staff determined that there was a serious problem and speculated that there must be a hole in the net. The staff lifted and corked the net to get the remaining fish and discovered a rectangular hole in the bottom of the net.

A Company report indicates that the total number of fish harvested from pen 12 on September 14 and 15, 1999, was approximately 14,190 fish. This includes mortality losses.

The Company states it responded by immediately lifting the damaged portion of the net out of the water. The company also reported that other measures were taken to respond to the escape. Feed was spread into the water from staff on the netpen system to get the fish to pool together near the surface. A boat was deployed to circle the system with staff spreading feed in the water in an attempt to get the fish to pool together. The company's intent was to try to encourage the escaped fish to surface and school with the hope of seining them with the equipment on hand. The company did not believe it would be very successful in this endeavour but felt that this was the best option available at the time. The fish did not respond to these efforts.

At 4:15 p.m., two contract divers arrived at the site and were sent into the water to inspect the three remaining netpens containing fish. One diver inspected pens 6 and 8; the other diver inspected pen 10 and also whether any fish remained in pen 12's predator net. Smaller holes were discovered in the three netpens still containing fish. The divers immediately repaired these holes. The divers reported that no fish were swimming in pen 12's predator net. The divers observed a "significant" amount of fish swimming outside of the pens. Total time that the divers were at the site was reported to be one hour.

The company reported this escape at 2:30 p.m. to Dr. Al Castledine, Manager, Seafood Development, Ministry of Fisheries. Atlantic Salmon Watch and Ron Ginetz of the

Department of Fisheries and Oceans were also notified by the company.

The company advised that if it had believed there was a reasonable chance of locating and recapturing the school of fish, it would have immediately deployed a seine boat and/or conducted an aerial survey, recognizing that it would have required a special harvest permit from the Department of Fisheries and Oceans. The company did not conduct an aerial survey of the surrounding areas. The company was of the opinion that given all of the circumstances, including limited water visibility, the uncertainty around the time of escape, and the lower depth patterns inherent in the particular species of fish (mowi), an aerial survey would not have been successful. The company did not employ the use of a vessel beyond the immediate vicinity of the site to attempt to locate the escaped fish

September 17, 1999:

At 10:00 a.m., one contract diver arrived at the site and dove pens 6, 8 and 10 to retrieve mortalities and check for any holes in the nets. No holes were reported. Total time that the diver was at the site was reported to be one hour.

As of the date of this report, the escaped fish have not been located or recaptured. Records provided by the company indicate that 31,621 pieces of Atlantic salmon escaped from pen 12. Weight of these fish averaged 5.9 kilograms. Hatchery of origin: Georgie Lake. Strain: Mowi. According to company officials, this represented a financial loss of \$1,338,777.50.

## **THE OPERATOR'S ESCAPE PREVENTION AND DETECTION PRACTICES PRIOR TO THE ESCAPE**

**Interviews with company officials and documents obtained during the course of the investigation indicate that the company employed the following escape prevention and detection practices at the Eden Island site prior to the escape:**

1. The company advised that it uses a manual tracking system that identifies the age, history and optimal period of usage for each net. The purpose of this "tracking system" is to ensure that only nets of appropriate quality and strength are used to contain fish. Company policy assumes that a net has a 5 year lifespan. The company is upgrading its tracking methods for ensuring the integrity of its nets, and anticipates that this automated system will be completed in the year 2000.



2. The company reported that every net is tested prior to being placed in the water and used to contain fish. The test identifies the tensile strength of the net. If it is determined that the strength of the net is below a specified percentage of its original strength, the net will not be used in a netpen to contain fish.

The investigation revealed that the pen 12 net was strength-tested by a net manufacturing, repair and testing company in April of 1998. The test revealed that the net condition was "good" and within acceptable limits for safe reuse. This was verified in an interview of an official from the net manufacturing, repair and testing company. The documentation of the test did not indicate any specific tensile strength.

3. The company advised that nets used to contain fish are dipped in a copper solution primarily to prevent marine organism fouling. The company reported that it discovered that a second benefit of dipping these nets is that it increases their weight and rigidity. This helps prevent successful seal and sea lion attacks on the fish. The manager of the net manufacturing, repair and testing company that tested the pen 12 net indicated that in his opinion, nets treated with copper antifoulant solution are more rigid and have a longer lifespan than untreated nets.

Documents obtained during the course of the investigation indicate that on April 25, 1998, the pen 12 net was shipped to a company that treats nets with antifoulant solution. The company advises that the net was placed in the water at the Eden Island site in mid-February, 1999. (approximate date). The investigation team observed that the net appeared to be treated with copper antifoulant.

4. The company reports that at the Eden Island site, shark guards were used at all netpens, including pen 12, to prevent attacks at the bottom from seals and sea lions. At pen 12, a shark guard was attached to the bottom of the containment net. The report from the net manufacturing, repair and testing company also indicated that a shark guard was attached to the pen 12 containment net. The company advised that it hung down approximately 10 feet below the bottom of the netpen.
5. The company has written policies and procedures aimed at minimizing fish escapes. These are intended to guide staff and include requirements for new net construction, antifoulant treatment, shipping of nets, installation, weighting and inspection of nets prior to fish entry, net handling, regular inspection and maintenance frequencies, and repair and evaluation of nets. The investigation team reviewed a copy of the policies and procedures.

The investigation team noted that the written policies and procedures did not include formal procedures on the "hanging" of weights to stabilize netpens, including guidelines for hanging or installing weights in a manner that ensures that the weights are lower than the lowest point of containment nets/shark guards. The company advised that this is a matter left to the discretion of individual site managers, who make decisions based on site-specific conditions and variables. Also, the company advised that certain weights are appropriately and routinely hung above the lowest point, such as circular "cannon-ball" weights. The investigation team was advised that the company's policies and procedures outlining preventive measures to

minimize potential fish escapes applied to pen 12.

6. Weekly visual inspections of each netpen are conducted by "mort" divers who, as part of their duties to remove dead fish from the pens, check the nets for holes or irregularities and carry out "on the spot" repairs of any holes. This is a required site practice as specified in the company's policies and procedures. The company provided dive inspection reports to the investigation team.

The evidence indicates that divers conducted the last weekly inspection of the pen 12 net on September 10, 1999, between 3:15 p.m. and 4:45 p.m. Other pens were also inspected at this time. The investigation team notes that the dive records for this date did not document any specific repairs. The team reviewed dive records for other key dates and noted that they did not document specific repairs. The company advised that dive records do not generally document specific repairs.

7. Daily monitoring of fish feeding behaviour in each pen is carried out by farm employees through the use of underwater video surveillance of fish and observing the feeding response from the surface. This allows for adjustments to feed quantities and frequencies if circumstances dictate. It is also a means of detecting an escape-related problem. An inspection of the Eden Island site was conducted by a BCF inspector on April 26, 1999, at which time it was reported that all sites have cameras for overseeing feed requirements.

Company records indicate that as of September 7, 1999, the fish in pen 12 were not being fed in anticipation of harvest.

8. In accordance with company policy, daily visual inspections of the area surrounding the pen are conducted by on-site staff from the surface to ensure that the integrity and stability of the structures and system are maintained, and to identify whether there are any escape-related indicators or problems, including sightings of any fish outside of the netpens.

According to the company, staff were present at the Eden Island site 24 hours per day during the period when the escape occurred. Staff had conducted routine surface visual inspections of the system, including pen 12 during that period, and had not observed anything that would indicate an escape had taken place.

9. The company maintains a records information system. The system documents daily and weekly feed quantities for each pen, inventory of fish on site, (number of fish stocked, harvested, lost to mortalities, lost to escapes), daily activities, mort dive inspections (including observed holes in nets), antibiotic treatments and loss accounts that describe escapes and corrective measures taken.
10. The company advised that during the harvest operations on September 14 and 15, 1999, it used "spotters". These staff observed the operations, which, in this case, included the "scooping" of fish from the netpen with a smaller net and the deposit of fish on the seine boat.

11. The company employs a Technical Manager who is responsible for identifying and reviewing various escape prevention and detection technologies, approaches and "best practices". The Technical Manager was interviewed by the investigation team.

## THE OPERATOR'S EXPLANATION

The exit point for the fish from pen 12 was a 15 foot by 5 foot hole at the bottom of the net as discovered and reported by the divers on September 15, 1999. A second hole, measuring approximately 2 feet long and adjacent to the larger hole, was likely a second exit point for the fish.

The company stated that in its opinion, the most likely explanation for the holes in the net leading to the escape was mechanical damage when the net snagged on one of the 450 pound weights attached and close to the net during the tides of the last 3 days prior to discovery of the escape. Company officials indicated that there had been an unusually high current flow this year. The company reported that the strength of this flow was likely compounded by the significant tidal fluctuations during the days before the discovery of the escape. It was suggested that the normal current flow in the area of the site, (considered high to begin with), may have been intensified by the significant increase in runoff from the snowmelt this year. This led to the extraordinary flow/current that may have caused the net to significantly billow and snag on the 450-pound weight. When the direction of the current reversed, the net was torn by the weight, causing the holes.

Company officials advised that approximately one year ago, at Eden Island, the weights were hung from the nets instead of from the sharkguards. This was due to the strong current flow conditions at the site. It was intended that this change in practice would result in greater stability of the netpens. This practice resulted in the netpen weights hanging at a point horizontally higher than, or parallel with, the lowest sag point of the nets and sharkguards. Company officials advise that until this event occurred, there were not any escape-related problems as a result of this change in practice. Company officials also indicated that this was the 5<sup>th</sup> year of operations at this specific site (3<sup>rd</sup> cycle).

Company officials indicated that it had been a common company practice at a number of its sites during the past 14 to 15 years of operation to use this specific kind of concrete weight (cylinder-shaped with smooth walls, with an upper surface of untrowelled concrete with a number of bent rebars inserted as potential attachment points). Officials indicated that in some cases, such weights have been hung in the water to stabilize containment nets that they were parallel with, or above the lowest sag point of the netpens. The company officials advised that it is extremely common that nets sag. However, it is less common that sagging nets come into contact with the weights when the netpen structure size/dimensions are the same or similar to netpen 12. This is due to the distance between the weights hanging around the perimeter of the netpen and the containment nets and/or predator nets, which allows for considerable sagging without net-weight contact. Company officials in positions of authority to make adjustments to the equipment at the Eden Island site, including the site manager, were interviewed by the investigation team, and stated that they had not been provided with any prior indications of a potential problem with this practice.

The company concluded that the smaller holes in pens 6, 8 and 10 were likely caused by stress from net weights and "extraordinary" current flow conditions of the last number of days. They may also have been caused from ordinary "wear and tear" given typical marine conditions. The company advised that such smaller holes were not uncommon.

Company staff advised that there was little evidence of a predator attack leading to a tear in the net, but acknowledged that this could still have been a possible explanation.

Company staff advised that prior to September 14, 1999, no unusual events were observed that would indicate the net had been torn or fish had escaped.

Company officials advised that the company emphasizes escape prevention in all of its activities and that this is common throughout the industry. There is a very strong incentive for escapes to be prevented, given the potential for economic loss.

### **THE OPERATOR'S ESCAPE RESPONSE PRACTICES AND MEASURES:**

The operator's immediate escape response practices and measures commenced on September 15, 1999, and are indicated in the report's chronological sequence of events.

The operator indicated that it was deeply concerned about the escape and would take whatever measures were required to ensure that it would not happen again. The escaped fish represented a financial loss to the company.

**In addition to the immediate escape response measures, the operator indicated that it was carrying out the following corrective measures to improve its escape prevention, detection and response practices:**

1. More frequent dive inspections of the nets are to be conducted. The scope of most dive inspections will be broadened to increase the level of scrutiny of containment nets.
2. At the Eden Island site, at any netpens that had continued to contain fish, the operator immediately increased the "hang distance" between the concrete weights and the netpens so that the weights were below the lowest sag point of the containment nets and sharkguards. This was achieved by hanging the weights from the sharkguards instead of from the nets. This ensured, according to the operator, that the weights were lower than the bottom of the pens by at least 6 feet. In turn, this reduced the chance of any net coming into contact with a weight if current flow conditions led to significant billowing. It should be noted that all fish have been harvested from the site as of the date of the report. A company representative indicated that the company is committed to improving its practices on an ongoing basis, and that it has learned from this incident and is taking measures to ensure that "hang distances" are appropriate.



3. All of the company's managers of other sites were instructed to ensure that netpen weights are hung from sharkguards instead of from the nets to reduce the chances of their nets coming into contact with the weights if current flow conditions lead to significant net billowing. The company is developing formal written procedures on the "hanging" of weights to stabilize netpens, including requirements for hanging weights from the sharkguard instead of the net to ensure that the weights are lower than the bottom of the pen. This will provide greater guidance and direction to site managers.
4. The company conducted a world-wide survey of netpen systems to identify any potential technological and practice-related improvements to its netpen systems.
5. The company is conducting a comprehensive review of its netpen weighting systems to identify any areas for improvement in weight design, weight surface texture, weight materials and weight fastening. The company indicated that it has never before experienced a similar incident in which concrete weights were involved, and that they are commonly used at many of its sites. It is conducting this review to be comprehensive in its efforts to ensure that a similar escape does not happen again.
6. Company officials travelled to the maritime provinces to review and assess alternative netpen weighting systems.
7. A managers' workshop was held to review key issues related to netpen systems, including net installation practices. It covered issues and practices related to netpen weights. Prior to the workshop, a video was taken of the bottom of the site to aid in the discussion related to current flow, billowing of nets, and weighting systems.
8. The operator is formalizing in writing its escape response policies and procedures in the near future. The company advises that the recapturing of escaped fish from any of its sites is a high priority, given the value the company places on environmental protection and conservation management as well as the economic value of the fish.
9. The net was sent to a net manufacturing, repair and testing company for evaluation, testing and repairs.
10. The company is reviewing the feasibility of employing the practice of having pre-harvest dive inspections of applicable pens.

**Note:** During the investigation, all fish were harvested from the site. As of the date of the report, the site has remained empty. The operator indicates that it plans on introducing fish at the site in March or April, 2000. At that time, the investigation team will conduct a "follow-up" inspection of the site to review and verify the corrective measures taken by the operator. The inspection will include an examination of the weights used to stabilize the netpens. The inspection will involve the use of the Ministry of Fisheries' underwater video camera (Remote Operating Vehicle) to provide direct images of the weights. Consideration will also be given to using divers to support the inspection. The investigation team has informed the Ministry of Environment, Lands and Parks Conservation Officer who has been investigating the escape

under the **Waste Management Act** that the team intends to conduct a follow-up inspection. The team indicated that the Conservation Officer may attend the inspection.

## **THE AERIAL SURVEY**

In planning the aerial survey, the BCF Senior Biologist calculated the most probable routes and distances the fish would have taken on escape. This included the areas of Tribune Channel into Fife Sound, to the entrance of Queen Charlotte Strait, and passages around the Insect Island Group, including Retreat, Arrow, and Misty.

Due to the weather conditions on September 19, 1999, a limited window of opportunity was available to conduct this survey. The aerial survey involved approximately 1.5 hours flying time in a floatplane. The BCF Senior Biologist and the Technical Manager, Stolt Seafarm Inc., participated in the aerial survey.

No large schools of fish were observed.

## **THE ENGLEWOOD PROCESSING PLANT**

On September 20, 1999, BCF staff Bob Friesen, Manager, Licensing, Inspection and Enforcement, Fisheries Management Branch; Charlie Twaddle, Chief Inspector, Inspection and Enforcement, Fisheries Management Branch; and Gary Caine, Senior Biologist, Sustainable Economic Development Branch, attended at the Englewood Processing Plant. The visit was requested by the company in order that BCF could have an opportunity to observe the appearance and quality of fish harvested from pen 12.

In the presence of BCF, the company opened several fish totes clearly identified with lot numbers connecting them with pen 12. Visual attributes of the fish appeared normal. Company officials indicated that the fish were not diseased and that 80 to 85 percent met the company's premium grade standard.

## **EXAMINATION OF THE NET**

On October 1, 1999, the net from pen 12 was examined in Campbell River by a BCF inspector with a company representative present. A second examination of the net was performed on October 18, 1999 by a Conservation Officer from the Ministry of Environment, Lands and Parks and by a member of the BCF team.



After the October 1, 1999 examination, a net manufacturing, repair and testing company conducted an inspection and evaluation of the net. The purpose of the evaluation was to examine the holes in, and assess the condition and strength of, the net. Strength tests were conducted in three different places throughout the net and around the larger hole. **The following was indicated from this examination:**

1. The net was originally built no later than 1994 and constructed of nylon.
2. The net had been treated with several applications of copper antifoulant.
3. Two holes were discovered. The largest hole in the bottom middle was measured potentially 15 feet long by 5 feet wide. A hole was found adjacent to the large one and measured potentially at 2 feet long.
4. The shark guard in the area of the holes was extensively torn.
5. In the opinion of the representative from the company conducting the evaluation, the strength test indicated "very good strength for a net of this age and its continued use for the next 2 to 3 years is probable". The representative also noted that aside from obvious damage to the bottom of the net, the net is in good shape.
6. The representative from the company conducting the examination noted that the tears (holes) were "consistent with something hooking on and pulling away" and these tears (holes), in the representative's opinion, occurred due to contact with the weight hanging close by.

**Note:** The company concluded that the smaller holes in Pens 6, 8 and 10 were likely caused by the combination of stress from net weights and "extraordinary" current flow conditions of the last number of days and that the holes could also have been caused from ordinary "wear and tear" given typical marine conditions. The company advised that such smaller holes are not uncommon. The representative of the net manufacturing, repair and testing company indicated that in his opinion, it was very common that small holes are caused in nets due to ordinary wear and tear and that this was a reasonable explanation. This was also the opinion of Ministry of Fisheries' staff who were asked to comment on this matter.

## **FINDINGS**

**The investigation team makes the following findings:**

### **I. CIRCUMSTANCES, NATURE AND CAUSE OF THE ESCAPE**

1. Given that the escape event occurred approximately 60 to 70 feet below the surface of the water and was not directly observed, any finding on the nature and cause of the escape of fish from the Eden Island Site is circumstantial in nature.

2. Some time between September 10, 1999 (after a mortality dive by the operator's contracted divers), and September 15, 1999 (when the escape was detected), the containment net at pen 12 was torn. The most likely cause for the tear, which resulted in 2 holes, was mechanical damage when the net snagged on the 450 pound weight that was closest to the holes. Current flow conditions led to net billowing, the net came into contact with the weight, the snag occurred, and the weight caused the holes in the net when there was a change in current flow direction. The fish escaped through these holes. The length, shape and nature of the tear supports this finding. The report provided by the net manufacturing, repair and testing company also supports this finding.
3. The evidence does not support a conclusive finding that the holes in the pen 12 net were caused by the following: vandalism, intentional or deliberate acts by the company, net condition and strength, net maintenance, debris, or predator attacks.
4. In the opinion of the investigation team, three factors in combination increased the likelihood that the snag and resulting holes occurred:

a) The Top Surface of the Net Weight

Concrete weights were used to stabilize netpen 12. These cylinder-shaped weights had apparently been constructed through the pouring of concrete into a prefabricated form. The walls of these weights were "rough". At the top of each cylinder, the concrete surface appeared untrowelled and "rough". Inserted into the top of a number of the weights, including the one closest to the holes, were bent rebars. It is likely that one of the bent rebars snagged on the net. The operator advised that similar concrete weights are commonly used at many of its other sites without incident.

b) The Proximity of the Net Weight to the Lowest Point of the Net

Evidence from company officials suggests that the vertical distance between the point where the concrete weight was connected to the net to the actual weight itself was anywhere from 7 to 15 feet. This meant that it was likely that the weight was hanging at a point horizontally higher than, or horizontally parallel with, the lowest point of the net and sharkguard (i.e. where the net and sharkguard sag down into the middle of the netpen structure). In the opinion of the team, this increased the likelihood that the billowing net would come into contact with the weight and sharkguard as opposed to the rope used to connect the weight to the netpen. One company official stated that at some of the operator's other sites, the weights are hung from sharkguards as opposed to nets to ensure that the weights are lower than the lowest point of the net. This is done to reduce the likelihood that significantly billowing nets would come into contact with the weights.

### c) Current Flow Conditions

In the days prior to and during the period when the escape occurred, current flow conditions were observed by staff to be "extraordinarily strong". Farm employees noted that the currents were strong enough to have had a visible "significant" billowing effect on the nets. On September 10, 1999, it was reported that the diver had to postpone a mortality dive for several hours due to too much tide. During the September 19, 1999 visit to the Eden Island Site, the BCF team observed that the metal walkway was twisted so that it was inclined several degrees from a horizontal plane. In the opinion of the team, billowing of the net caused by current flow conditions resulted in the net coming into contact with a weight.

**Note:** There was no objective data available on current flow conditions at this specific location for the period when the escape occurred; the only available evidence was anecdotal supplemented by direct observations of the BCF team.

5. There are insufficient grounds, in the investigation team's view, for a finding that the harvest operation on September 14 and 15, 1999, contributed to the escape by inducing more fish to exit through the holes in the net. However, it is very possible that due to the process of harvesting, some fish were moved closer to the holes, thus increasing the likelihood that they would escape. This may have been the case in light of all of the circumstances, including the fact that the holes were at the bottom of the net and that the general tendency of the mowi strain of Atlantic salmon is to swim at lower depths.

## II. OPERATOR'S ESCAPE PREVENTION AND DETECTION PRACTICES

1. In the opinion of the team, a number of the escape prevention and detection practices exercised by the company appear to be consistent with current industry practice. These include: the use of a sharkguard or predator net in addition to the actual containment net, regular mortality dives at each site in which net examination is either part of the procedure or a by-product of the divers' inspection, taking measures to ensure that nets placed in the water are of appropriate condition and strength, routine visual inspections of netpens by staff, and maintaining a records-information system.
2. The team is unable to provide an opinion on whether the following practices, which were employed by the operator at netpen 12, are consistent with current industry practice. However, in the opinion of the team, these practices may be considered "diligent practices": mandatory testing of the net, which had been previously used, by an independent company prior to the net being placed in the water; adherence to minimum tensile strength requirements; use of approved copper antifoulant treatment, and written escape prevention policies and procedures to guide staff, including requirements for new net construction, antifoulant treatment, net shipping, installation, weighting, inspection prior to use, handling, regular inspection and maintenance frequencies, and repair and evaluation.

**Note:** The determination of "current industry practice" and "diligent practice" is based on the opinions of the BCF Finfish Aquaculture Specialist and the Chief Inspector. The Finfish Aquaculture Specialist and Chief Inspector have, in total, over 18 years of involvement with the salmon aquaculture industry. Both indicated the need for a current and comprehensive survey of the industry to keep abreast of any recent changes in industry practices in escape prevention, detection and response.

3. The company's practice of monitoring fish behaviour when fish are being fed is, in the opinion of the team, consistent with industry practice. During the period in which the escape occurred, (between September 10 and 15, 1999), the fish in netpen 12 were not being fed in anticipation of harvest. The company's practice of not feeding the fish in pen 12 prior to harvest also appears consistent with current industry practice.
4. The team is unable to provide an opinion on whether the following practices employed at netpen 12 are consistent with current industry practice:
  - a) Using a concrete weight.(with an untrowelled concrete surface at the top of the cylinder and bent rebars as potential attachment points) as a netpen weight.
  - b) Hanging this kind of concrete weight so it was not likely to be lower than the lowest point of the net and sharkguard where the net and sharkguard sag down into the middle of the netpen structure.
5. In the opinion of the investigation team, the operator's harvest procedure of using "spotters" was consistent with current industry practice.
6. There are insufficient grounds, in the investigation team's view, for a finding that the operator's staff on site should reasonably have detected and responded to the escape on an earlier basis.
7. In the opinion of the investigation team, there are insufficient grounds for a finding that the company did not take "reasonable precautions" to prevent an escape. This is based on all of the circumstances, including the available evidence and the lack of regulatory standards defining or clarifying the term "reasonable precautions".

### III. OPERATOR'S ESCAPE RESPONSE PRACTICES

1. It appears that the immediate escape response practices taken by the operator when the escape was detected are consistent with industry practice in the event of a similar escape event. This includes pulling the damaged area of the net out of the water if possible, given the circumstances, spreading feed from the system into the surrounding water to look for a response from the escaped fish, deploying a boat to further broadcast the feed, and sending divers down to identify the problem.
2. The evidence, in the investigation team's view, does not support any conclusive finding on whether the immediate response practice of pulling the damaged area of the net out of the water on September 15, 1999 led to the escape of more fish from Pen 12 by inducing more fish to exit through the holes in the net. However, it is possible that this process may have led to some fish being moved closer to the holes or may have forced some fish through the holes, increasing the likelihood that more fish would escape. This may be due to all of the circumstances, including the fact that the holes were at the bottom of the net and that the general tendency of the mowi strain of Atlantic salmon is to swim at lower depths.
3. The operator did not have any formal, written policies and procedures outlining escape response procedures for staff.
4. It cannot be guaranteed that another escape will not occur at the site. However, it is the opinion of the team that the corrective measures indicated to have been taken by the operator will significantly reduce the chance of re-occurrence given similar circumstances. **Note:** Prior to any restocking of the Eden Island Site, the BCF investigations team will inspect the operation to verify that all of the corrective measures have been taken.

### IV. OTHER FINDINGS

1. The **Aquaculture Regulation** requires an operator to take "reasonable precautions" to prevent an escape. This requirement is incorporated in the standard aquaculture license. There are not any regulatory standards defining or clarifying this requirement for government officials, industry or the public.
2. As of the date of this report, there were not any **B.C. Fisheries Act and Aquaculture Regulation** provisions requiring specific escape prevention, detection or response standards, measures, practices, procedures, systems, equipment and structures that must be included in any salmon aquaculture license and adopted by any salmon aquaculture operation before a license can be issued.
3. With the exception of the requirement for operators to report to the BCF Manager of Aquaculture an escape, evidence suggesting an escape, a recapture, or an attempt to recapture, there are not any specific **B.C. Fisheries Act and Aquaculture Regulation** provisions expressly requiring an operator to take reasonable measures to respond to an escape, including initiating a search and recapture initiative if reasonable in the circumstances.



4. There are not any **B.C. Fisheries Act, Aquaculture Regulation** or aquaculture license provisions that expressly enable the Ministry of Fisheries to order an operator to take escape response measures, (including locating and recapturing fish) and to recoup costs from an operator for any Ministry of Fisheries' actions taken in response to an escape, such as conducting an investigation and, where required, attempting to locate and recapture escaped fish through aerial surveys and/or chartering appropriate vessels.
5. A preliminary review of other jurisdictions suggests that there are a number of issues that should be considered by the British Columbia government and the industry when developing regulatory standards of operation. See **Appendix A**.
6. The operator was very co-operative with the BCF investigation team.

## **RECOMMENDATIONS FOR THE OPERATOR**

**It is recommended that prior to restocking of the site, the operator implement measures satisfactory to BCF that it has ensured that the complete system is suitably designed and installed to withstand the environmental conditions at the Eden Island site. This includes taking corrective measures aimed at minimizing the chance that its net weights will come into contact with containment nets, and that if any contact occurs, the chances of an entanglement are negligible.**

Monitoring of fish behaviour during feeding periods through surface observation or underwater camera viewing is one key method of identifying whether an escape may have taken place or whether other problems may exist.

When fish are not being fed in anticipation of harvest, a surface visual inspection may not necessarily reveal that an escape has taken place or related problems exist. Fish behaviour, including swimming near the surface within visual range of staff, varies depending on a number of factors, such as species and water conditions.

**It is recommended that during any periods where fish are not being fed in anticipation of harvest, the operator ensure there are appropriate practices and measures in place to detect an escape on a timely basis. This matter should be reviewed on an industry-wide basis.**

Harvest activities, including docking the harvest vessel, seining procedures, and actual brailing, are periods where the risk of an escape is higher. Harvesting activities should be closely monitored during these periods. On-site staff should exercise caution before reaching a conclusion that a problem in seining a required amount of fish on reasonable effort is due to reasons other than an escape, and that if there is any doubt, staff should err on the side of caution.



**It is recommended that the operator review its harvest procedures and practices to ensure that any indicators of a potential escape problem are clearly identified and recognized by on-site staff. The review should determine whether it is reasonable that a pre-harvest/seining inspection (by divers or other means) be conducted to ensure that the containment nets are, in fact, free of holes and tears. This matter should be reviewed on an industry-wide basis.**

In the opinion of the team, any successful attempt to recover escaped fish is predicated on immediate detection and an organized response by the operator. Staff must be well-versed in escape detection and response procedures.

**It is recommended that the operator formalize its escape response policies and procedures in writing and communicate these to all staff.**

### **RECOMMENDATIONS FOR GOVERNMENT AND INDUSTRY TO DEVELOP ESCAPE PREVENTION, DETECTION AND RESPONSE REGULATORY STANDARDS OF OPERATION**

The fundamental role and obligation of the provincial government, as a licensing authority responsible for the regulation of the salmon aquaculture industry, is to protect the public interest. This means that the provincial government should provide a regulatory climate that supports economic growth, stability and sustainability for the salmon aquaculture industry but only in accordance with the highest standards of health and safety, and conservation management and environmental protection.

**It is recommended that on a priority basis, the British Columbia Ministry of Fisheries lead an initiative to identify and implement, in a timely manner, appropriate escape prevention, detection and response standards for open netpen operations. These standards must provide a regulatory climate that supports economic growth, stability and sustainability for the salmon aquaculture industry but only in accordance with the highest standards of health and safety, and conservation management and environmental protection.**

Development and implementation of these standards should provide government, industry and the public with a greater degree of certainty and stability.

#### **Nature of Escape Prevention, Detection and Response Regulatory Standards of Operation**

**It is recommended that the standards of operation for open netpen systems be legally enforceable by the B.C. Ministry of Fisheries. Therefore, the standards of operation should be codified in legislation or regulations and/or included as terms and conditions of any aquaculture license. Note: The investigation team will refer to these legally enforceable standards as "regulatory standards".**

**It is recommended that the regulatory standards of operation for netpen systems be clear and measurable to provide greater certainty for industry and ensure that operator compliance can be more effectively assessed, supported and enforced by provincial authorities.**

**It is recommended that the regulatory standards of operation apply to all British Columbia salmon aquaculture netpen operations.**

**It is recommended that as part of the initiative to develop regulatory standards, the provincial government review the nature and extent that salmon farm compliance with any new escape prevention, detection and response standards of operation will be assessed. This should include a review of various compliance assessment models and means, such as audits, inspections, investigations, evaluation of information provided by operators through self-monitoring and self-reporting.**

#### **Process for Developing Regulatory Standards**

**It is recommended that the initiative to develop escape prevention, detection and response standards for open netpen systems be open and transparent.**

**It is recommended that proposed standards be developed by government and industry. A discussion paper containing the proposed standards should be made public in order that other stakeholders have an opportunity to comment.**

**It is recommended that regulatory standards be based on an identification of “best practices” which could and should reasonably be required of all British Columbia salmon aquaculture operators.**

**The discussion paper should identify and review potential escape prevention, detection and response practices which could be incorporated as regulatory standards for the operation of open netpen systems in British Columbia. It is recommended that the discussion paper address the following:**

- Identification of key principles which should guide the development of regulatory standards of practice;
- Review of best practices currently employed in British Columbia and in other jurisdictions;
- Review and analysis of key legislation, regulations, license terms and conditions, standards, and approaches in other jurisdictions, including Scotland, Norway, the maritime provinces, and Washington State;
- Identification of potential regulatory standards of practice for the British Columbia salmon aquaculture industry – for discussion and consultation purposes;
- Assessment of the financial and other key impacts on operators and others of the potential regulatory standards of practice;

- Evaluation of the compatibility of the proposed regulatory standards with the physical, geographic, environmental, and current operational and practice regime in which the B.C. industry operates;
- Examination of whether the potential standards will realistically result in a decrease in the number of escapes from open netpen systems;
- Review of costs to provincial government compliance and enforcement authorities;
- Discussion of whether it is in the "public interest" that escape prevention, detection and response standards for open netpen systems be "traditional/prescriptive" or "outcome/performance-based" in nature.

**It is recommended that the Ministry of Fisheries initiate and sponsor a joint government-industry workshop in support of the development of proposed escape prevention, detection and response regulatory standards of practice for netpen systems. It is also recommended that the workshop focus on identifying and disseminating information on best open netpen system escape prevention, detection and response practices employed in British Columbia and in other jurisdictions.**

**It is recommended that the Ministry of Fisheries, in consultation with the industry, develop a comprehensive plan ensuring that appropriate escape prevention, detection and response regulatory standards will be developed and enacted on a priority basis. The plan should include the following:**

- Identification and commitment of resources;
- Regulatory standards completion deadline;
- Terms of reference, goals and key activities;
- Establishment of process and structure to manage and coordinate the initiative;
- Consultation Strategy, including: co-ordination of government and industry workshop, development of discussion paper and approach ensuring that other stakeholders are provided with an opportunity to comment on proposed standards.

#### **Specific Issues for Consideration in Development of Legislative-Regulatory Standards of Operation for the Salmon Aquaculture Industry**

**The team recommends that the development of escape prevention, detection and response regulatory standards of practice for the British Columbia salmon aquaculture industry reflect the following:**

- Open netpen system equipment must be designed, installed and used in a manner that minimizes the likelihood of an escape.
- Open netpen systems must be adequately and appropriately monitored, evaluated and maintained to minimize the likelihood of an escape and ensure that if an escape occurs, it is detected and addressed on a timely basis.
- Key aquaculture operation activities, including fish handling, transporting, feeding, monitoring, seining, brailing and harvesting need to be carried out by adequately trained staff in a manner that minimizes the potential for an escape.

- Escapes must be detected on a timely basis to ensure that there is greater likelihood of a successful response that minimizes any impacts.
- Operators should be responsible and accountable for the escape of fish from their sites, including implementing reasonable measures to maximize the chances of locating and retrieving escaped fish.

**It is recommended that a number of issues be considered in the review and development of regulatory standards of operation for the salmon aquaculture industry. Some were identified during the review of other jurisdictions; others were identified as diligent practices currently exercised by Stolt Seafarm Incorporated; others arose in response to the specific escape incident. Some issues were identified by the Ministry of Environment, Lands and Parks; others by the investigation team members as they conducted the investigation. See Appendix B.**

## **RECOMMENDATION FOR COMPLIANCE STRATEGY**

In the opinion of the investigation team, it is critical that the Ministry of Fisheries be in a position to monitor, and where required, enforce industry compliance with any new escape prevention, detection and response regulatory standards.

**It is recommended that the Ministry of Fisheries implement, on a priority basis, a Compliance Strategy comprised of key legislative and operational initiatives aimed at strengthening its compliance and enforcement capabilities. It is recommended that industry, government and other stakeholders, including environmental groups, be fully consulted to identify recommendations for strengthening the Ministry's compliance and enforcement role and capabilities. See Appendix C for an outline of components that should, in the opinion of the investigation team, be considered for inclusion in a Compliance Strategy.**

## APPENDIX A

### REVIEW OF OTHER JURISDICTIONS

The investigation team reviewed, on a preliminary basis, the finfish aquaculture regimes in Nova Scotia, Newfoundland, New Brunswick and Washington State to identify whether these jurisdictions had enacted any specific requirements or standards in legislation or regulations to address the following:

1. Whether there are any design requirements or prohibitions for netpen weights.
2. Whether there are any installation requirements or prohibitions for netpen weights.
3. Whether there are any special escape detection requirements that apply when finfish are not being fed in anticipation of harvest or for any other reason. (For example: regular use of divers and/or underwater camera technology).

The investigation team was unable to identify any specific requirements or prohibitions in legislation or regulations for any of the above, with the exception of Newfoundland. It was determined that in Newfoundland, industry and government are implementing a "Code of Containment" that provides standards and requirements for operations of the finfish aquaculture industry in Bay D'Espoir. According to a representative from the Newfoundland provincial government, adherence to the Code of Containment is a condition of any aquaculture license. The issues of netpen weight design and installation appear to have been considered. The Code specifies that "Net weights shall be installed in such a manner to prevent net chafing" A second document called the "Code of Containment Implementation Plan" indicates that "Net weights are hung at down lines one foot above the bottom of the cage. Net weights are of smooth plastic;...". It should be noted that the Code applies to a small, geographically concentrated finfish aquaculture industry and that the type of netpens used in Bay D'Espoir may be significantly different than those used by the British Columbia salmon aquaculture industry.

In the opinion of the investigation team, there generally appears to be significant variation between these jurisdictions in the content, scope and degree of specificity of escape prevention, detection and response regulatory standards of operation. This seems to be due to a number of jurisdiction-specific factors, including the state of development and maturity of the finfish aquaculture industry, the nature and magnitude of the industry, the provincial economic climate, the level of public and government support for the industry, the particular species of finfish (indigenous or non-indigenous) and the potential or perceived impact on the environment of an escape, and the physical, geographic, and oceanic conditions.

Notwithstanding the differences between jurisdictions, a number of escape prevention, detection and response regulatory standards of operation issues were identified which should, in the opinion of the team, be considered by the British Columbia government and industry. These issues are included in **APPENDIX B**.



## **APPENDIX B**

### **ISSUES FOR CONSIDERATION IN THE DEVELOPMENT OF REGULATORY STANDARDS OF OPERATION FOR THE SALMON AQUACULTURE INDUSTRY**

#### **1. Human Resource Standards**

##### **Adequately Trained Staff**

It is recommended that government and industry review the need for regulatory standards requiring aquaculture operators to ensure that their staff are adequately trained to conduct activities in a manner that minimizes the potential for escapes and that if escapes occur, they detect and respond immediately and appropriately.

##### **Policies and Procedures**

It is recommended that government and industry review the need for regulatory standards requiring aquaculture operations to develop policies and procedures to guide staff in conducting key activities in a manner that minimizes the potential for escapes and that if escapes occur, staff detect and respond immediately and appropriately.

##### **Presence of Staff**

It is recommended that government and industry review the need for a regulatory standard requiring operators to ensure that staff are on site at all times when fish are contained at the site in order that any escape-related problems are detected and addressed immediately and appropriately. It is recommended that the review include an identification of technologies, approaches and human resource strategies which may provide alternative means of ensuring that escapes are prevented, detected and addressed as soon as possible.

#### **2. Aquaculture Operation Open Netpen Systems Design and Equipment Standards**

##### **Aquaculture Systems Designed by Approved Professionals**

It is recommended that government and industry review the need for a regulatory standard requiring operators to ensure that aquaculture systems, including netpens, are designed by approved professionals, including, where required, engineers, oceanographers and biologists.



### **Equipment Designed to Minimize Potential for Escapes**

It is recommended that government and industry review the need for a regulatory standard indicating that any and all equipment, materials and structures employed at an aquaculture site or in support of an aquaculture operation, including net weights, must be designed to minimize the potential for escapes by various causes and means, including damage/holes/tears to nets through entanglements with other equipment. It is recommended that government and industry review the need for the development of, and if warranted, create a schedule identifying, approved types, characteristics and features of equipment, including netpen weights, which meet this standard. The review should include an assessment of the cost to industry.

### **Equipment Installed to Minimize Potential for Escapes**

It is recommended that government and industry review the need for a regulatory standard indicating that any and all equipment, materials and structures employed at an aquaculture site or in support of an aquaculture operation, including net weights, must be installed in a manner that minimizes the potential for escapes by various causes and means, including damage/holes/tears to nets through entanglements with other equipment. It is recommended that government and industry review the need for the development of, and if warranted, create installation standards for key equipment, including nets and weights. The review should include an assessment of the cost to industry.

### **Minimum Equipment Standards**

It is recommended that government and industry review various netpen equipment technologies, equipment and approaches with the aim of identifying minimum equipment standards that could and should be required at any site. The review should include an assessment of the cost to industry. It is recommended that government and industry review whether the following should be required:

#### **Containment Nets**

- Specifications for minimum breaking strengths for new and used nets.
- Strength-testing of all new containment nets prior to placement in the water.
- Strength testing of all used containment nets in accordance with specified frequencies.
- Documentation of strength-test results by operators and retention of documentation for audit purposes.
- Mandatory review by Ministry of Fisheries' inspectors of containment net adequacy on a regular basis, including auditing the documentation on containment net strength tests that have been conducted by operators.
- Mandatory marking or tagging of any containment net with the manufacturer's name, year produced, original breaking strength and original net dimensions.
- That net mesh size be of a dimension that ensures containment of the smallest fish in the enclosure.
- That certain types of containment nets and other equipment be treated with antifoulant that is federally approved.

- That certain types of containment nets and materials be U.V. ray protected.

### **Additional Protection Against Predator Attacks**

- Additional protection (i.e. in addition to the containment net and antifoulant treatment) against predator attacks - through the employment, where required, of shark guards, predator nets, etc.

### **Netpen Weights and other Equipment**

- That all netpen weights and other equipment shall be designed and installed with the aim of minimizing the chances of entanglement with containment nets and/or predator nets/shark guards. **Note:** It is recommended that as part of the review, a world-wide survey be conducted, (including the British Columbia industry), to specifically identify "best" net weight design and installation practices and measures with the aim of disseminating information on these approaches to all British Columbia operators.
- That propeller guards shall be required for all boats and vessels used to support an aquaculture operation if the boats come in close proximity to containment nets.

## **3. Netpen System Monitoring, Evaluation and Maintenance**

In the opinion of the investigation team, given the nature of marine conditions and the impact of these conditions on equipment, a critical element in minimizing the likelihood of an escape and in detecting and responding to an escape on a timely basis is appropriate monitoring, evaluation and maintenance of netpen systems.

### **Regular Monitoring and Inspection of Key Underwater Equipment**

It is recommended that government and industry review the need for a regulatory standard that all active containment nets and other key underwater equipment, such as netpen weights, shall be routinely and regularly monitored and inspected by divers, that inspection frequencies be specified and on a basis that ensures that any damage/holes/tears are identified and repaired as soon as possible, that any escapes are detected on a timely basis, and that dive inspections are documented and retained for audit purposes. It is recommended that there be an examination of other technologies that may provide an alternative means of identifying, on a timely basis, whether active containment nets have been damaged/torn, that an escape has occurred, and/or whether adjustments/repairs/modifications are required to the netpen system, including the positioning of netpen weights in relation to containment nets. The review should include an assessment of the cost to industry.

### **Regular Monitoring and Inspection of Key Above-Water Equipment**

It is recommended that government and industry review the need for a regulatory standard that all key active netpen system "above-water" equipment be monitored and inspected on a regular basis, and that the inspections be documented and retained for audit purposes.

### **Use of "Spotters" During All Critical Activities**

It is recommended that government and industry review the need for a regulatory standard that "spotters" be required during all "critical activities" (i.e. activities where there is a demonstrably higher risk of an escape).

### **Inspection of Nets and Equipment Prior to Harvesting, Seining and Brailing Activities**

It is recommended that government and industry review the need for a regulatory standard that all operators ensure that applicable containment nets and equipment are inspected (by divers or other means) immediately prior to the conducting of seining/brailing/harvesting activities.

### **Policies and Procedures for Equipment Monitoring, Evaluation and Maintenance**

It is recommended that all operators be required to develop written policies and procedures for the ongoing monitoring, evaluation and maintenance of key equipment, including containment nets.

### **Records-Information System to Track History of Active Containment Nets**

It is recommended that all operators be required to develop a records-information system that tracks the history of all active containment nets, including age, manufacturer, strength tests, U.V. protection applications, antifoulant treatments, maintenance and repair history, inspection history, and critical damage history.

## **4. Escape Detection**

Escapes must be detected on a timely basis to ensure that there is greater likelihood of a successful response that minimizes any impacts.

It is recommended that government and industry specifically review the need for, and if so, the content of, regulatory standards that would require all operators to detect escapes or related problems on a timely basis. The review should focus on identifying and examining the best escape detection practices and technologies that could and should be employed during various aquaculture operation activities, including periods when fish are not being fed in anticipation of harvest, and during seining, brailing and harvesting activities. The review could include, for example, an assessment of the feasibility of using underwater cameras and other technologies and/or more frequent deployment of divers around the applicable pens during periods when fish are not being fed. The review should include an assessment of the cost to industry of such practices and technologies.

## 5. Escape Response

### Elements of Reasonable Escape Response

In the opinion of the investigation team, as soon as an escape is detected, a reasonable operator response should, unless circumstances dictate otherwise, include the following:

- Immediate identification and assessment of the cause of the escape.
- Immediate corrective action to prevent the escape from increasing in magnitude.
- Immediate action to ensure that escaped fish are removed from the area outside of the site; including initiating various measures aimed at locating and recapturing escaped fish.
- Immediate notification of appropriate authorities of escape and escape response activities and plans.
- Remediative actions aimed at minimizing or eliminating the impact of escaped fish on the environment, if an impact has been identified.
- Corrective action aimed at ensuring that the chance of a similarly caused escape event is significantly reduced, whether at the site in question or at any of the operator's other sites.
- Appropriate documentation of response activities and outcomes, or rationale for not carrying out key activities.

### Reasonable Measures to Respond to Escape

It is recommended that operators be required to take reasonable measures to respond to an escape and that the **Aquaculture Regulation** should be amended, if necessary, to ensure that this standard is legally enforceable. It is possible that the "reasonable precautions to prevent escape" provision in the **Aquaculture Regulation** could be interpreted to include escape response, however, it is recommended that this question be reviewed and, if required, clarified through an amendment to the **Aquaculture Regulation**.

### Escape Response Standards

It is recommended that government and industry conduct a comprehensive review of the best escape response standards, practices and approaches employed by British Columbia operators and in other jurisdictions with the goal of developing appropriate escape response regulatory standards that are consistent with the above suggested key elements of a reasonable escape response. The review should include an assessment of costs to industry.

### Required Equipment and Technologies

The review should identify any equipment and technologies that should be required to be located at, or on immediate standby for, any active site or for specific kinds of "high escape risk" activities to ensure an effective and timely response to an escape. The review should identify the costs to industry of using any such equipment and technologies.

## **Tracking and Locating Escaped Fish**

The review should include initiating a specific research project that identifies any special technologies that could allow for the tracking and location of escaped fish, including radio transmission devices that could be inserted into fish, branding, and chemical tracking. The review should identify the costs to industry of using special technologies and whether any regulatory standards are required.

## **Policies and Procedures for Timely and Effective Response**

The review should identify any policies, practices and procedures that should be required for any active site to ensure an effective and timely response by staff to an escape.

## **Legislation and Regulation**

### **Provisions Supporting Operators' Escape Response Efforts**

The review should identify and assess the need for legislation or regulations that support operators' efforts in responding to escapes, including ensuring operators retain ownership of escaped fish within a specified radius of a site.

### **Authority for Ministry of Fisheries to Respond to Escapes**

The review should identify and assess the need for legislation or regulations that provide the Ministry of Fisheries specific authority, where there are reasonable and justifiable grounds:

- to order an operator to conduct various escape response activities, if deemed necessary, including corrective and remediative actions;
- to undertake initiatives aimed at locating and removing/recapturing escaped fish;
- to recoup costs from an operator for any government activities conducted in response to an escape, including investigations and attempts to locate and/or recapture escaped fish.

## **6. Escape Management Plans**

### **Escape Management Plans to be Developed for Each Site**

It is recommended that all operators be required to submit "Escape Management Plans" to the Ministry of Fisheries as part of the aquaculture license application process. "Escape Management Plans" should incorporate escape prevention, detection and response regulatory standards into the specific operations of each aquaculture site.

### **Escape Management Plans to be Reviewed and Approved by Ministry of Fisheries**

It is recommended that Escape Management Plans be reviewed and approved by the Ministry of Fisheries prior to an aquaculture license being issued or renewed.



### **Term and Condition of Aquaculture License**

It is recommended that any approved Escape Management Plan be incorporated as a term and condition of the aquaculture license.

### **Pre-Standards Aquaculture Licenses**

It is recommended that if regulatory standards have not been developed by the provincial government and industry, any new, renewed or amended aquaculture licenses ensure that "Escape Management Plans" will be submitted within a reasonable period of time for Ministry of Fisheries' review and approval when escape prevention, detection and response regulatory standards have been developed.



## **APPENDIX C**

### **RECOMMENDED COMPLIANCE STRATEGY INITIATIVES**

- 1. Development of "Enforcement Section" in New Aquaculture Act or Improved Fisheries Act. Includes:**
  - Articulation of overall principles of Act and application of Act by government authorities;
  - Requirement for annual public report by Minister of Fisheries on state of industry compliance, including the number of annual escapes and recommendations for industry and government;
  - Strengthened compliance and enforcement powers for Ministry of Fisheries' inspectors;
  - Strengthened penalties for non-compliance;
  - Mediation and dispute resolution mechanism.
- 2. Compliance and Enforcement Manual for Ministry of Fisheries' Inspectors. Includes:**
  - Standards for conducting investigations of escapes;
  - Clear and measurable salmon aquaculture operator compliance indicators based on escape prevention, detection and response regulatory standards;
  - Standards for more rigorous monitoring and inspections of aquaculture operations.
- 3. Improved Ministry of Fisheries' Information System. Includes:**
  - Development of automated case tracking and information management system for Ministry of Fisheries' Inspectors to support investigations of escapes and provide improved provincial statistics and other information on escapes and other compliance matters.
- 4. Formalizing Arrangements for the Provision of Expert Advisory Services to Support Ministry of Fisheries' Compliance and Enforcement Program.**
- 5. National Conference of Provincial Fisheries Inspectors on Best Compliance and Enforcement Standards and Practices. Includes:**
  - Review of feasibility of inter-jurisdictional inspector exchange program.
- 6. Review of the Feasibility of a "Compliance Certification" Program for the Salmon Aquaculture Industry. Includes:**
  - Assessment by Ministry of Fisheries of operator compliance/non-compliance with escape prevention, detection and response regulatory standards and issuance of Compliance Certificate if within acceptable range;

- Incentives for operators who have achieved exemplary levels of compliance, including: reduction in the number of annual site inspections, permitting such operators to move towards a performance-based, self-reporting system;
- Greater scrutiny of operators who have not met minimum requirements, including: higher numbers of on-site inspections and spot audits, and other measures.

**7. Improved Communications with Industry and General Public. Includes:**

- Provision of information bulletins on an ongoing basis from the Ministry of Fisheries to the industry on various compliance-related matters;
- Development of “best practices” registry/information-sharing base;
- Development of Ministry of Fisheries’ website containing information on its compliance and enforcement program, public reports, and public/industry suggestions/recommendations for improvement mechanism;
- Public and stakeholder consultation plan.

**8. Human Resource Strategy to Strengthen the Ministry of Fisheries’ Compliance and Enforcement Program. Includes:**

- Development of specialized, “in-house” training program for Ministry Inspectors on compliance and enforcement methods and new regulatory standards;
- Review of technology and equipment needs of Inspectors with the aim of increasing compliance monitoring capacity;
- Review of Compliance and Enforcement program organizational structure, including review of models in other jurisdictions, and identification of resources required to ensure monitoring and compliance with new regulatory standards.

## EXECUTIVE SUMMARY

On September 15, 1999, Stolt Seafarm Inc. reported to the Ministry of Fisheries (BCF) that there had been an escape of Atlantic salmon from its Eden Island site. Staff from BCF Inspections and Enforcement Section have now completed an investigation into the circumstances, nature and cause of the escape.

The report outlines the events based on the available evidence and a description of the corrective measures taken or planned to be taken to reduce the chances of a similar escape happening. The report makes findings and recommendations for government and the salmon aquaculture industry regarding escape prevention, detection and regulatory standards of operation.

In summary, a containment net was torn and 31,621 Atlantic salmon averaging 5.9 kilograms escaped through two holes. The two holes were most likely caused when the net snagged on a 450-pound weight that was used to stabilize the net. The investigation team concluded that three factors, in combination increased the likelihood that the snag and resulting holes occurred: current flow, weight design and weight installation.

The investigation team concluded that there were insufficient grounds for a finding that the company did not take "reasonable precautions" to prevent an escape. This is based on all of the circumstances, including the available evidence and the lack of regulatory standards defining or clarifying the term "reasonable precautions". The investigation team determined that this matter did not warrant any charges under the *BC Fisheries Act*, Aquaculture Regulation.

## RECOMMENDATIONS

The recommendations were based on the particular escape event and what could have been done to prevent the escape. Recommendations focussed on actions for the operator, for government/industry, and for government regarding compliance issues.

These include the following:

- BC Fisheries should identify and implement appropriate escape prevention, detection and response standards for open netpen operations.
- BC Fisheries should review the need for a regulatory standard that all-active containment nets and other key underwater equipment, such as netpen weights, shall be routinely and regularly monitored and inspected by divers.
- Operators should be required to take reasonable measures to respond to an escape and that the Aquaculture Regulation should be amended, as necessary, to ensure that this standard is legally enforceable.
- An approved Escape Management Plan should be incorporated as a term and condition of the aquaculture license.